PETROLEUM GAS.

ITS MANUFACTURE

And its value in comparison with other Illuminants.

ITS CAPABILITIES

WHEN WELL MADE,

And its consequences when poorly made.

The value of all illuminants depends upon the amount of good and safe light they will give, rather than on their mere bulk.

A gas company is a manufacturer and seller of LIGHT, and is guilty of gross negligence when it forces upon its consumers gas by the cubic foot, regardless of the amount of LIGHT it contains.

One foot of good petroleum gas will give as much light and for as long a time as five feet of good coal gas.

Adopted by the following organizations in Penna.:

SUNBURY GAS CO.,
PHILA. & READING R. R. CO.,
ASHLAND GAS LIGHT CO.,
SHAMOKIN GAS LT. CO.,
MAHANOY CITY GAS CO.,
SHENANDOAH GAS CO.,
BLOOMSBURG GAS LIGHT CO.,

Entered according to Act of Congress, in the year 1874,
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PREFACE.

In preparing these memoranda for the information of the public, although actuated principally by a desire to extend a legitimate business in which I am protected by my various patents, it is my earnest desire to give to the public reliable data in plain language regarding the general question of public illumination.

And I do this with a full and resentful knowledge of the many frauds that have been and are being perpetrated, and of the falsehoods that have been told in this branch of industry.

J. DESHA PATTON.

TREVORTON, Pa., August, 1874.

PETROLEUM GAS.

APPARATUS FOR ITS MANUFACTURE.

These memoranda are intended more particularly for the information of persons about to erect gas works, either for public or private use (although they may convey some instruction to those who are already engaged in the manufacture of illuminating gas, and it must be borne in mind that all technicalities and assumptions have been omitted for the sake of that simplicity and clearness without which they would be of no use to persons unexperienced in gas works and manufacture.

The evident cheapness of petroleum as a source of light has led to innumerable attempts to use it for the production of illuminating gas, and all these attempts have necessarily had some degree of success for the reason that the transposition of petroleum into something in the form of gas, and sufficiently resembling it to be called gas, is so easy that the clumsiest attempts couldn't well fail to produce either gas or vapor. The trouble has been to produce a **fixed gas with regularity and certainty,** and to do this so well and thoroughly that the three great difficulties in the operation, viz: Smoking, condensing, and depositing of tar, and other obstructions in the apparatus and its connections, should be avoided, and yet keep the apparatus within such simple form as to be within the easy comprehension and power of management of ordinary intelligent labor.

The test of the practical utility of any mechanical or manufacturing operation is not that it will work when in the hands of its inventor, or of a person of peculiar skill; but the practical question is, will it work in ordinary hands, and will it perform its duty not only when in perfect order and in careful hands, but, after it has become old and when subjected to the various vicissitudes incident to its position and use in every day working?

Especially, and above nearly all other apparatus, is a gas works required to be punctual and regular in its workings. **and the more nearly an apparatus or process approaches the fulfillment of these conditions without fully accomplishing their comparison with other illuminants, the more liable it is to deceive.**

It is customary in measuring the lighting power of coal gas to compare a burner of the sort best adapted to that gas and consuming **five cubic feet per hour** with a sperm candle consuming 120 grains of sperm per hour, and the gas is called 10, 12, 14 or 16 candle gas accordingly as the five foot gas flame gives 10, 12, 14 or 16 times as much light as the single candle.

Applying the same rule to petroleum gas we see that a consumption of five feet per hour will give as much light as 70 to 80 candles, so that **five cubic feet** of coal gas or **one cubic foot** of Petroleum gas or (average) from 14 to 16 sperm candles, will each give the same amount of light for one hour, and this fact, namely, that **one foot of petroleum gas will last as long and give as good a light as five feet of coal gas,** is the basis upon which its great economy rests, and the light it produces, estimated at first cost, is actually cheaper than that of common coal oil estimated at first cost.

It may be as well to premise that in the manufacture of illuminating gas from coal, which process consists of heating the coal in red hot retorts, cooling the product thus obtained, and purifying it with water and lime, the amount of gas so obtained averages something under four cubic feet of gas from each pound of coal. Under ordinary circumstances this gas is consumed, as we see it in ordinary use, through burners of iron or lava, each of which consumes from **three to twelve** cubic feet per hour—the average being between five and six feet. This average burner, as ordinarily used, gives a light of from 12 to 16 candles, and will maintain a flame of that brilliancy if it is of good quality, and the burner is well adapted to its work, for an hour—using in that time fully five cubic feet of gas, so that the illuminating value of five cubic feet of good coal gas, in ordinary use, is equal to the amount of sperm consumed by say 14 (average between 12 and 16) standard candles per hour, allowing 2 grains per minute or 120 grains per hour, (the customary allowance for each candle,) we have $14 \times 120 = 1680$ grains $\div 437 = 3.85$ ounces avoirdupois of sperm as the equivalent in lighting power of five feet of coal gas, and omitting fractions, one pound of sperm will give as much light as twenty-one feet of gas: at $4.00 per 1000, which is something less than the average price in the U. S., the 21 feet would cost 8.4-10 cts., so that the light from coal gas—**if of good quality**—is equal in price to that from sperm or other equal material at 8.4-10 cts. per pound. Petroleum in its refined form of kerosene, burned in a good lamp, gives a flame equal to that of six candles for a consumption of one fluid ounce in 76 minutes, showing that one fluid ounce of kerosene is worth $6 \times 76 \times 2 = 952$ grains, or somewhat over two ounces avoirdupoise of sperm, and consequently one pint (16 fluid ounces) is equal in illuminating value to over two pounds of sperm or forty-two feet of coal gas.

The manufacture of petroleum into gas instead of into refined kerosene, can be accomplished at even less expense than that of refining, when operated on the same scale, and the result is that the production of one gallon of crude oil or crude naptha in the form of gas will give a fraction more light than an equal amount of refined oil consumed in a lamp.

CAUSE OF SUPERIOR LIGHTING POWER.

The specific gravity of fixed gas made from petroleum is twice that of coal gas and five-sixths that of air, and it **contains five times the amount of illuminating elements that are found in coal gas. These elements, while existing in coal gas to the extent of about 8 per cent. are found in petroleum gas to the extent of 40 per cent., and are the cause of its manifold superiority.**

MODES OF USE.

To be available in general use this excessive richness of petroleum gas requires some special provision for supplying it with air for combustion. If the supply of air is insufficient the combustion will be imperfect, and the result will be that the very elements which should give light will pass off in the form of smoke. All known illuminants will do the same thing under equivalent circumstances, and therefore we provide for kerosene artificial drafts of air, and burn coal gas in burners adapted to its demands; either of these methods will answer the same purpose for petroleum gas and there is also a third—namely, dilution by admixture of air or non-illuminating gas with the petroleum gas.

The first of these—the artificial draft—involves the use of glass chimneys, and is objectionable to the extent of the cost and care of those chimneys, except in such special cases as stand lights, &c., where ornamentation or particular use render the employment of glass desirable.

The third—dilution—is a clumsy attempt to imitate coal gas, and is liable to the following grave objections:—

The purpose of dilution are three, viz:

1st. To make a compound that will burn in coal gas burners.

2nd. To increase the bulk of the gas so that the **consumer will be compelled to burn a large quantity of gas in order to get a given quantity of light.**

3rd. To support and conceal the large quantity of petroleum vapor resulting from imperfect modes of manufacture.

All of these are reprehensible because the dilution, if made with non-illuminating gas, costs money both in the erection and maintenance of works, and if made with large quantities of air, is dangerous, for the admixture of air and any illuminating gas will form an explosive mixture, requiring only the proper proportions, and these are to a certain extent liable to occur whenever by accident or design an undue quantity of air is administered.

The increase of bulk for the second reason is merely an attempt to blind the consumer as to the quantity of gas required for his wants, and in concert with a nominally low price by the cubic foot, to make him believe that he is

supplied with a cheap gas, while on the contrary the price in view of the attenuated condition of the gas, is very high. The result of this is that the consumer is injured, and **feels** that such is the fact without knowing exactly how it is done. This objection also exists to the dilution of coal gas, in which case it is usually accomplished by allowing the coal to remain in the retort at high heat, after the more valuable portions of the gas have passed off and while it continues to yield a quantity of gas having little or no illuminating value. and adding to the bulk of gas in the gasometer without adding to its illuminating power.

The third reason is equally bad and is adapted to allow the palming off of vapor or imperfectly made gas instead of the genuine article, and involves all the objections appertaining to the other two reasons, besides being the common resource of those parties fraudulently representing apparatus as making "fixed gas," the only product of which is a mixture of gas, vapor, air &c., utterly unfit for purposes of general illumination—and which, when put to that use, results in smoking at the burner, loss of light, and deposits of tar, &c., in the pipes.

"AIR GAS" OR "GASOLINE" APPARATUS.

The various styles of "air gas" or "gasoline" apparatus operate by passing air from a fan, or blower, over or through a quantity of very light refined petroleum, known as gasoline, from which it imbibes a quantity of illuminating elements, varying according to the quantity of material used, and according to the temperature at which it is volatilized. **When this is used directly from the apparatus, without the intervention of a meter,** and is not compelled to pass through long lengths of cold pipe, and is placed underground and out of doors at a safe distance from the building to be lighted, it usually answers a good purpose; but is not reliable for long lengths of pipes or large numbers of burners. This mode of using petroleum for illumination, although scarcely coming within our subject, is so nearly allied to it, especially in its diluted phase, that it seems well to give this brief description of its operation and capacities.

All the various gasoline apparatus attains precisely the same end by various means, viz: It mixes air and petroleum vapor and conveys it to the burners in mechanical, not chemical combination, and is available under certain circumstances where the product cannot become chilled, in which latter event it loses its luminosity and becomes dangerous.

THE PROPER MODE OF USE.

The remaining mode of using petroleum gas, viz: By providing for its consumption burners specially adapted to it, and from which it is ejected at the rate of about 1 foot per hour, in sheets so thin that they receive air enough for perfect combustion from the natural draft, just as an ordinary coal gas or candle flame does. This seems to me to be the rational way to use it. I have heard but one fair objection urged against it, viz: That **it doesn't use gas enough.** The light yielded by one foot being equal to that yielded by five feet of coal gas, it follows that each consumer of gas would use just *one-fifth* the bulk formerly required—and the view taken by the gas companies is that the substitution of this rich gas for coal gas, even though it could be done without cost, would nevertheless result in a financial loss, because the entire gross receipts would then not be as much as the profits now are.

GAS COMPANIES AND GAS CONSUMERS.

The question thus brought up is that of the mutual relations and requirements of a gas company and its consumers, and in this it cannot be denied that the object of the company is profit, and that of the consumer is **light** and the proper view of this is that one is a buyer and the other a seller of **light** and the mere bulk of material passing between them is not a criterion of value any more than the size of a U. S. note is of its value.

Gas companies, where not spurred by competition, are usually unreasonable in requiring payment for gas with entire disregard to its illuminating value, and on the other hand gas consumers would be very apt to think themselves aggrieved at being called on to pay more by the cubic foot for good gas than they have been accustomed to pay for poor gas.

REGISTRATION OF LIGHT IN DOLLARS AND CENTS.

As a compromise measure between these adverse interests I have adopted the registration of gas by statement directly in dollars and cents, and make the obligation of the gas company to the consumer to furnish him with a given amount of **light** instead of a given amount of **gas.**

At Shamokin, Ashland, Mahanoy City and Shenandoah City, the stated price is one cent and a half per hour for a 14 candle flame—equivalent to ordinary coal gas at $3.00 per 1000, the usual rate in that neighborhood being from $4.00 to $5.00—and the meters are so graded as to supply sufficient gas to keep the flame above 14 candles for one hour while registering 1½ cents. This makes a standard more just and more comprehensible to the gas consumer than the registration in feet—and experience has shown me that it is satisfactory to both parties.

COMPARISON IN POINT OF ECONOMY WITH COAL GAS.

The cost of manufacturing petroleum gas, undiluted, and coal gas, when made in equal quantities being about the same **per cubic foot,** it follows that the **light** as furnished by the former is cheaper just in proportion as the gas is more luminous, and this being the proportion of 5 to 1 in favor of petroleum gas, in other words petroleum gas **light** is five times cheaper than coal gas **light** and this is the actual and practical difference in the financial value of the two gases so far as the production of light is concerned. It however does not extend to heating power.

The advantages of petroleum gas over coal gas are found not only in its production, but also in the apparatus for its manufacture and distribution. A gasometer capable of holding 8000 feet of coal gas and supplying the wants of a small town, would, when filled with petroleum gas, contain as much light as 40,000 feet of coal gas, and would be sufficient to supply a large town.

MANUFACTURE AND GENERAL DESCRIPTION.

The manufacture of petroleum gas requires a very careful adjustment of heat for—

If it be heated too much, the destruction of illuminating power, by depositing the carbon, is very great; and if not heated enough the decomposition is not effected, and instead of a permanent gas the result is a vapor which will condense on cooling. It is, therefore, necessary to secure just the proper degree of heat, and this I do by a simple arrangement for the GRADUAL heating of a stream of oil, through the various liquid and vapor states, up to that point at which it becomes a fixed gas, and is then immediately passed out toward the gasometer.

The result is that the oil is manufactured into fixed gas with the least possible waste; the lighter grades requiring less heat, and therefore working up more rapidly than the heavier grades.

In practice I have obtained the best results from crude Naptha, which is the cheapest form of petroleum in the market.

The gas is safe and reliable under any circumstances that coal gas is, and under some that coal gas is not. For instance: it requires a larger and more perfect admixture of air to make it explosive, and does not deteriorate under extreme cold or pressure, as coal gas does. For the latter reason, as well as on account of its vastly greater lighting power, it is eminently adapted for the **lighting of cars and to other uses in transitu. Simplicity and safety** are the two great desiderata in gas making apparatus for general use. The simplicity of this is such that any person of sufficient intelligence to be a fireman or brakeman could manage a works after three or four days' practice.

The practical result of the greater brilliancy of this gas is not that a burner using it will give five times more light than one using coal gas in the same quantity; **but that a burner using one foot of this gas per hour will give as much light as a burner using five feet of coal gas per hour;** and that for any illuminating purpose one foot of it will answer as well as five feet of coal gas. Therefore a gasometer of 10,000 cubic feet capacity, filled with this gas, **would contain as much light** as one of 50,000 cubic feet capacity filled with coal gas—a matter of practical economy, allowing **a saving of four-fifths** in that item, **and this same proportion of economy, as compared with coal gas, extends throughout the system, subject to local variations.**

Wherever the gas is made **for use** and not for sale, this economy will be appreciated as soon as known. Where petroleum gas is made for sale, it should be at prices based upon the **light furnished** and not upon the **bulk used.** Where this is done, and the results of the economy are shared alike by the producer and consumer, it cannot fail to give satisfaction to both sides.

For existing gas works and as an auxiliary to coal gas it can be used to bring gas of an inferior quality up to any desirable standard of illuminating power, so that a very large yield of inferior gas could be obtained from a ton of coal, and the addition of a small quantity of petroleum gas would bring its quality up to the proper standard; or a ton of coal now producing 8,000 feet of 16 candle gas would make 12,000 feet of $11\frac{1}{2}$ candle gas, the addition to which of 1,000 feet of petroleum gas would make 13,000 feet of gas fully equal in quality to the first 8,000 feet. Or again, the bituminous coals of our western States—making six or seven candle gas—might be used, and the gas made from them enriched up to whatever quality was desired.

The difficulty heretofore experienced in the manufacture of petroleum gas arose from want of proper means to apply a heat sufficient to make fixed gas and not sufficient to produce destructive decomposition, and the consequent formation of tar and other refuse in the retorts and pipes. At a lower heat the product is a mixture of fixed gas and vapor, unfit for general illuminating purposes. Many devices have been tried to use this vaporous compound for practical illumination with more or less success so far as the cheapness and brilliancy of the light is concerned, but wanting regularity and often dangerous.

Other devices do not attempt to make a fixed gas, but rely upon carrying the raw vapor of the lighter gasoline suspended in air or in non-luminous gas. In these cases also the light is well known to be brilliant and cheap, but is liable to vary with the weather or with the specific gravity of the petroleum employed.

The product of one barrel of petroleum or gasoline is equal to that of nearly two tons of coal in lighting power, and the cost of production is very small. It is not necessary to dilute the gas before using—an idea industriously cultivated by those **whose interest it is to produce a large number of cubic feet of dilute gas.**

Petroleum gas can be used pure as readily as any other gas, but not in any burners (in common use) consuming more than two feet per hour, and the best results are obtained from the one foot lava-tip "bat-wing" burner which gives a light of from fourteen to nineteen candles, or about the same as a common six foot burner with coal gas.

From works built in 1871, the citizens and borough of Sunbury, Pa., have been supplied by the undersigned with petroleum gas, and have expressed their satisfaction in a letter saying that "there is nothing better or cheaper in the way of illumination," and signed by all the principal consumers.

The price charged to them is one cent an hour for each light. The street lamps are supplied at the rate of $3.00 each for **gas and attendance**, including lighting and extinguishing.

Under my more recent patent the simplicity of the process is such that the cost of works and the labor of manufacture are reduced to a minimum. There is no machinery to get out of order, nor work to be done except to keep up the fire and allow the oil to flow in a small stream into the retorts. The smallest retorts I am using are four inches in diameter and three feet long, and make gas enough in one day to last an ordinary residence for many days.

The gas, when made, is preferable to coal gas, both in safety and permanence as well as in brilliancy and cheapness. For enriching coal gas it is unsurpassed. And when the average gas company can be brought to see that their true policy is to furnish good gas—**even if the consumers do save something thereby**—petroleum gas will have a large field opened for it as an auxiliary to coal gas.

At present the demand for gas from small towns, communities, factories and individuals affords the best field for the introduction of an illuminant which can be made on a small scale to almost as good an advantage as on a larger one.

COST OF MANUFACTURE.

The cost of petroleum gas **in oil and fuel,** estimating oil or crude naptha at $3 per barrel, and coke or other equal fuel at 10 cents per bushel, is about $1.50 per 1000 feet **pure gas** or 30 cents per 1000 when estimated by or diluted to coal gas standard, and the labor is much less than is required to produce an equal amount of coal gas.

The wages depend so much upon locality, &c., that it is scarcely possible to estimate them further than to say that the smaller sized works (for private use, factories, &c.) would require the attention of one person, man or boy, for 8 or 10 hours once or twice a week, and works to supply towns having a population of from 1000 to 6000, would require the attention for 10 or 12 hours daily of one good man ; and for a population greater, an additional man would be required so as to run the works at night also, as well as in day time.

Allowing then for oil $3.00 per barrel and for coke 10 cents per bushel, and for labor $60 and $75 per month, and moderate estimate of sales of gas-light at a rate equal to $2.00 or $2.50 per 1000 feet for a town of 1000 population, with a few street lamps and about 50 general consumers, which would be equal to $200 per month, we have a gross revenue..... $200 00

Expenses :—Wages, one man.....	$60 00	
" Fuel and Oil.....	30 00	125 00
" Repairs and incidentals	10 00	
" Allow'ce for Collec., &c	25 00	
Leaving a balance equal to 9 per cent on $10,000,.....		$75 00

For a town of 6000 population with street lamps and 300 general consumers consuming the equivalent of from 500,000 to 600,000 feet of coal gas per month, we could safely expect a gross revenue per month, $1200 00

Costing to Produce—Wages of 1 man.....	$75 00	
" Fuel and Oil,.....	180 00	$350 00
" Repairs & incidentals	35 00	
Expenses of Collections and accounts	60 00	
Leaving a balance per month of.....		$850 00

Equal to 30 per cent on $34,000 annually.

For 10,000 population the average value of gas sold would probably be, at a moderate estimate. per month..... $2,000

and would cost : Wages of 2 men, at $60 @ $75,	$135	
Fuel and oil.....	300	580
Collection, &c.....	100	
Repairs and incidentals.....	45	
Leaving a monthly profit of.....		$1,420

or 50 per cent. per annum on $3,400.

For private works the expense would be from $15 per month upwards **including labor,** and omitting labor, from $5 per month upwards. In most cases the labor of gas making for individual or factory use could be performed by persons already employed and having other duties to perform, so that the cost of labor in such case would not really add anything to the expenses of the establishment. and in no event would the cost of the gas even in this small quantity exceed ½ or ¼ that usually paid for coal gas.

GENERAL REMARKS.

The introduction of petroleum gas into general use has had to contend with numerous enemies who from various interests have combined against it, and has been greatly hindered by the false and fraudulent representations and character of various apparatus claiming to manufacture it, but in reality producing a troublesome and dangerous compound, dubbed with the name of some would-be genius and claiming to be the ne plus ultra of light and heat; and which will operate just long enough to cover the pretended guarantees of its inventor, and enable him to sell out the stock which he has taken for a portion of his profits under the pretense that he too is investing money in the "enterprise."

The modus operandi of these "enterprises," both in coal gas and "patent gas," is usually the formation of a joint stock company, the getter up of which proposes to "erect in your town a gas works if you will only, by way of showing your good will, take one half or one third of the stock, the parties erecting the works to take the remainder as an investment." The gas works are supposed to cost the full amount of the stock and the subscription by the builder of one half that sum is considered an earnest of his belief that it is a good investment, but the fact is that he puts up a concern costing less than the cash paid in by the local subscribers, pockets the balance and then sells his stock at the first available opportunity

In this way many coal gas works costing from $12,000 to $18,000 have been built and passed off as the basis of a paid up capital of $50,000 and $60,000, and petroleum gas concerns worth only their weight in old metal and not costing more than half as much as the coal gas works, have been put off at equal prices.

Another advantage of petroleum gas is that it can be manufactured on a small scale to almost as good an advantage as on a large one and so can be within the reach of the smallest communities and even of single residences or factories. In larger factories it is especially desirable not only for economy, but from the fact the cold weather of winter, which is just the time when light is most needed, does not in the least deteriorate it, and that is the very time when coal gas becomes pale from loss by condensation, and when gasoline apparatus refuses to work.

FOR LIGHTING CARS AND STEAM BOATS.

The lighting of Rail Road Cars and Steamboats afford a sphere of usefulness which it will undoubtedly fill, and **which cannot be properly and safely filled by any other known illuminant.** In this branch of the enterprise the Philadelphia & Reading R. R. have taken the initial steps, and the statement of results will be found among the appended letters and extracts, as soon as time will permit a correct and full statement of the results they obtain, from their new works now just completed at Reading.

SUPPLY OF MATERIAL.

It is urged by the opponents of petroleum gas making that if it comes into general use there will ensue such a rise in the price of oil as to raise the cost of petroleum gas light to a level with that of coal gas light. How slender a basis this **hope** rests on can be seen in the fact that the amount of petroleum required for the gas making of all the gas works in the United States would not be more than about 1-30th of the daily production of the Pennsylvania wells and in the case of new works every barrel of oil used will save at least ½ barrel of kerosene, and as in turn the production of that ½ bbl. kerosene requires nearly a whole barrel of crude oil, it is easily seen that there is enough petroleum for all probable demands upon it,—even in the event of its general adoption, by all the coal gas works in the country.

The appended letters and statements may throw additional light on this subject, giving as they do the practical results and observations of a considerable experience in this branch of industry, and if considerable repetition is found in them it should be remembered that they were written or the most part in answer to certain specific inquiries and to meet alleged objections—and last but not least to expose the deceptive points of gas apparatus wonderful in its claims and worthless in its use.

J. Desha Patton.

TREVORTON, North'd Co., Pa.

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GAS MAKING AND GAS USING.

Written for the National Oil Journal.

Among all the rapidly improving arts conducive to health, comfort and safety, there is nothing that has made so little advance as the art of gas making. All improvements adopted in that line do not tend to make gas one particle better than it was fifty years ago. And the reason is simply this: gas company policy has decided that **it pays better to make poor gas**—the yield from a ton of coal is much greater, and the number of feet required for a given quantity of light is correspondingly greater. This is carrying the rule of "Buy in a cheap market and sell in a dear one" to its utmost extreme, and beyond this the companies do not look. We can hardly expect corporations endowed by special laws with special privileges amounting usually to absolute monopoly, to be amenable to any moral perceptions not enforced by the courts; but if we can induce them to look beyond the narrow policy which is now their *vade mecum* and show them that self interest is in favor of their self improvement, something may be done to soften the feelings usually existing between the gas companies and their customers. The

financial soundness of any policy tending to give increased light to consumers for the same money is much doubted, because, as is **known** by the companies and **felt** by the consumers, the poorer the gas is the larger the bills are; a result that would not be if the circumstances were governed by the usual laws of trade. But gas companies are usually monopolies, and as such care little for complaints or dissatisfaction of customers. It is undoubtedly true that to produce the best results and largest dividends, companies will adopt such standard of price and quality as will yield the largest gross revenue. That there *is* a certain standard of price and quality in each locality which will produce a larger monthly average of gas revenue than any other standard, is evident, and it seems to me equally apparent that this standard is not an extreme one. It must be neither so high as to compel consumers to closely economize or abstain from the use of gas, nor must it be so low as to be merely nominal. Between these extremes is a wide range. Let us take for example a small works, supplying a town of 4,000 people, consuming about 8,000 ft. per day of ordinary gas at $4.00 per 1000 ft., and paying the gas company $960 per month of thirty days. With the ordinary burner, consuming five feet of gas at a cost of 2 cents per hour, and yielding an average light, this rate is a grievous tax. The average illuminating power of coal gas as used by the consumer under these circumstances is abont twelve candles. The increase of this lighting power to twenty-four candles would give the consumers a double portion of light for the same money, and I hold would be an absolute gain to the gas company for the following reasons:

1st. The richer gas will not cost the company any more by the foot than the poorer gas.

2nd. Very few consumers would reduce the size of their burners or number of their lights in consequence of the increase of light.

3rd. All consumers having pipes and connections with the mains would use them freely, for twenty-four candle gas at $4 per 1000 ft. is as cheap a light, all things considered, as kerosene at ordinary retail prices.

4th. Many who had hitherto not used gas would do so as soon as they found that its light was as cheap as other light.

I know that this is not the belief of the companies, but it is following out the sound commercial maxim "Honesty is the best policy," and if they will persist in making the largest possible amount of gas from a ton of coal, they would be consulting their true interests, if they enrich this large bulk, at least up to the standard which they claim for it.

As the prosperity of gas companies depends more upon the amount of their gross revenue than anything else, sound policy indicates that such price should be obtained as will yield the largest revenue. It is evident that such

price should not be **too low** or **too high**. For ordinary coal gas in this State an average of $1.75 is too low and $3.50 per thousand is too high. The mean is between these figures, probably about $2.50 for about 14 candle gas, or $5 for 28 candle, and $7.50 for 42 candle, $10 for 56 candle and $12.50 for 70 candle gas, at which prices the gas light is about equal in cost to the kerosene lamp light, at usnal retail prices. This fact once established, any person, rich or poor, who could get gas would use it, in preference to kerosene, and help to swell the gross revenue. Coal gas cannot be profitably made in small quantities at this (the 14 candle), and cannot be made of the succeeding named qualities at all, except by enriching. Oil gas can, if allowed the advantage of its greater brilliancy. A flame from good coal gas, from a 5 foot open burner, is equal to the light of about 14 candles, and would cost at $2.50 per one thousand 1¼ cents per hour. Oil gas would supply the light with 1 foot per hour, and, therefore, at the same price per hour would yield the gas company $12.50 per one thousand cubic feet.

People in general look upon the cubic foot as an established unit of value and would refuse to acknowledge the cheapness of any gas at $10 or $12.50 per one thousand feet, but would readily acknowledge its cheapness at 1 or 1¼ cents per hour for a good gas light.

As to the manufacture of petroleum and coal gas together, I do not see any thing beyond my arrangement is needed. There is no difficulty in mixing—mixers are a nuisance; all that is needed, is to place the two gases in the same holder, and they will freely commingle under natural laws, and if they would not, it would be useless to mix them mechanically and hope for them to stay in positions unnatural. Please understand that I speak strictly of petroleum *gas*, and not of petroleum *vapor*.

The general idea seems to be to use petroleum gas mixed with large proportions of atmospheric air, or non-illuminating gas, so as to conceal the presence of petroleum vapor, and to compel the consumer to burn a large quantity. If people are to use petroleum vapor and air, they had better get air gas machines at once. But gas well made from petroleum of any gravity, whether naptha, crude oil or paraffine (I prefer the former), will burn with entire satisfaction *pure* in batwing ½ to 1 foot burners, or in union jet burners up to 2 feet, and give a light in the former equal to ordinary and in the latter equal to 10 feet coal gas burners. Dilution, even with air, costs money, and is in several respects hurtful. Certainly people who advocate, and practice the mixing of petroleum gas with air, or hydrogen gas, for the purpose of giving it bulk, or for a worse purpose, should not find fault with those who believe in mixing it with coal gas.

J. D. P.

(B)

PETROLEUM GAS.

A FEW OF THE FRAUDS IN THE BUSINESS.

Written for the National Oil Journal.

Among the many different ways of making light from petroleum, it is natural that every inventor should claim that his way is best, and in order to prove that fact will sometimes make assertions, which unfortunately for the inquirer, can be **apparently proved, and cannot be readily disproved, and yet are very far from representing the true state of the case.**

My investigations lead me to believe that the illuminating power of a gallon of petroleum is about equal to that of 17½ lbs. of sperm. A gallon of oil or naptha well made into gas gives about the same amount of light as a gallon of oil burned in a good lamp, and in either case the light obtained is equal to that, within a fraction, of 17½ pounds of pure sperm candles. Results claiming materially more than this should be regarded *cum grano salis*, and be scrutinized very closely.

I do not wish or intend to charge willful falsehood upon persons making such statements, for I believe, in a majority of cases, they have deceived themselves, and are firmly convinced that they see clearly.

How easy this self-deception is to an enthusiastic, sanguine man, especially where his own interests or preconceived convictions are involved, I give the following general examples :

For instance, A. B. and C. have each an invention.

A's process starts with twenty barrels of oil in a still, and heat is applied ; five thousand feet of gas are made and measured : then the quantity of oil is measured and it is found that nineteen barrels remain. Therefore, it is plain, (isn't it ?) that a barrel of oil made five thousand, and twenty barrels would make one hundred thousand feet of gas. Any school boy could figure this up, and none but those experienced in the matter would know that when the nineteen barrels of oil remaining in the still cooled off they would not measure eighteen barrels, and that over two barrels of **the very cream of the material** had been taken to make that five thousand feet of gas, and before those eighteen barrels were used it would be found that the heavier portion of the oil, settling to the bottom, could not be used by A's process at all.

B's process mixes hydrogen gas or a large amount of common air with petroleum gas, and of course there is no limit to the **number of feet** B. can make from a gallon of oil—unless the water or air gets scarce. B. has heard that petroleum gas is of eighty or one hundred candle power, so he calls his gas eighty or one hundred candle gas, and tells you he can make one hundred, or two hundred or three hundred feet of gas from a gallon of oil. His statement of feet may be correct, but the deception is in the candle power.

C's process is, (*in appearance*,) a little fairer than the others. He makes gas from petroleum without dilution or adulteration as B., or without expansive measure like A.; but he makes a gas at low heat heavily laden with hydro-carbon vapors and drives it through a one foot burner under high pressure, (it would smoke like a torch under low pressure), and finds that the burner gives the light of twenty or twenty-five candles. It is a one foot burner, burns one foot in an hour. There is the single ring put on it by the maker of burners in attestation of that fact. But C. either does not know or forgets that the burner under the pressure he puts upon it consumes two feet per hour, the recognition of which little fact in his calculations would reduce his candle power one-half. So much for C's candle power. Then for his quantity. He does not measure the same gas and vapor of which he obtained anywhere from twenty-five to fifty feet from a gallon of oil, but he subjects another gallon of oil to intense heat and makes say, eighty feet of gas, two-thirds of the lighting power of which has been deposited in the form of carbons in the retorts, or tar in the pipes, and the gas is actually not much better than good coal gas. But it proves that he can make eighty feet, (may be more), of gas to the gallon, and he has already "proved" the quality to be one hundred (may be more), candles.

Beside A., B. and C. there are others who borrow a little from each of these plans and make statements and prove them in similar ways and with a similar enthusiastic overlooking of the truth.

To test the working of a petroleum gas apparatus fairly: First, there should be no gas or volatile hydrocarbon in the holder or between the retort and the holder. Second, **the material to be used should be of carefully ascertained quantity and quality, and the entire amount measured should be used.** Third, the measures of lighting power and of production per gallon of oil should be **accurately** made **from the same sample.** Fourth, the gas should be subjected to temperature not above zero and should be found by **long continued trial,** to make no deposit in the pipes or burner, and to show no tendency to smoke. Fifth, the process should be simple, cheap and safe, and should work rapidly and uniformly.

Results thus obtained are the ones upon which the comparison of various apparatus should be made. And if, under these circumstances the gas is not permanent at all temperatures, and free from smoke or oiliness; or if there is any considerable waste (i. e., carbon in the retorts or condensed matter in the pipes), or any evidence or appearance of unsafeness about the apparatus, it is not worth while to waste time in further investigation.

J. D. P.

(C)

NOTES ON PETROLEUM GAS MAKING.

For the Nat. Oil Journal.

It seems to be unfortunate for the advancement of petroleum gas into more general use that no process or system however crude or unscientific can well fail to achieve a certain degree of success and to produce results which, while the apparatus is new, or carefully manipulated, are sufficient to deceive a person unacquainted with gas making. A single plain retort of almost any size or shape will, while it is kept clean and carefully worked on short runs, come as near to filling the "guaranteed" performances of the generality of petroleum gas works as they themselves will.

Another point to which I desire to call attention is that, in statements of results obtained from petroleum gas making and burning, it is not possible to give them with the absolute and unvarying accuracy usually claimed. Even though the quality and quantity of the material and of the decomposing heat **are controlled with absolute uniformity** the expansion and contraction in volume, by changes of temperature in the gasometer, are sufficient to materially affect estimates of the candle power. The contraction and expansion being about one per cent. for every three degrees change of temperature it follows that one thousand feet of gas measured with the thermometer at thirty-two degrees would increase by expansion to one thousand one hundred feet at sixty-two degrees, and yet would contain exactly the same elements **and give just the same aggregate light,** being if eighty candle gas at thirty two degrees, only seventy-three candle gas at sixty-two degrees. This apparent difference, amounting to ten per cent. in the yield, is liable to occur frequently in actual practice, and, if taken advantage of, will tend materially to cover overstatements.

When gas is made and stored at a temperature above sixty-two degrees it is very liable to carry with it, if not well made, a considerable proportion of petroleum vapors which will condense upon becoming colder, and so make the contraction still greater, and, to the extent of the condensed vapor, irrecoverable.

In making gas, the cruder the apparatus used the more probable is the obtaining of a **large yield in cubic feet but not in light.**

A common gas retort, at high heat, and a workman of little skill, can easily get eighty to one hundred or more feet of gas from a gallon of oil, **and yet waste the bulk of its lighting power.** But it takes a scientific arrangement and a skillful workman to get fifty or sixty feet as the entire yield of a gallon of oil, **and yet representing its entire lighting power.** The difference in favor of the latter being that the gas thus made will give a magnificent light for a consumption of one foot per hour, while the other will give an ordinary light for a consumption of four feet per hour and will leave the greater portion of its lighting power to choke the retort and pipes in the form of carbon.

J. D. P.

(D)

TREVORTON, Sept. 1st, 1873.

EDITORS SCHUYLKILL REPUBLICAN—Gentlemen :—In your issue of August 30th, you have an article on "Kromshroder Gas," touching which a few words of explanation may not be out of place.

This "gas" which is not a gas, but only a mixture of vapor and air, though a new thing in England, is quite common in this country where we see it as the product of the various "gasoline gas machines," with which the process is identical.

In common with other similar methods (whereby our English cousins are being introduced to the beauties of raw gasoline as an illuminant) known as "Ruck's method," "new gas," "air gas." &c., it depends **wholly on petroleum naptha, commonly known as benzine or gasoline for its lighting power.**

The admixture of air or non-luminous gas does not add one particle to the lighting power of the benzine vapor; only serves to float it to the place of consumption, which in cold weather must follow closely on the production, or the mixture will resolve into its original elements to the great annoyance and danger of the consumer.

As long as highly volatile gasoline is used, and the weather is not cold, such a concern will work. But with crude benzine or petroleum at any time, or with best gasoline in our winters, it cannot work.

The handsomest way I know of to get up a real searching explosion is to saturate air with "hydrocarbon vapor," and then freeze nearly all the benzine out of it and touch it off.

There is a good deal of excitement in English gas circles just now about petroleum gas and its cheapness, as evinced by the number of modes for using gasoline for an illuminant. Now, if **refined** gasoline in England at 18 pence, or say 40 cents currency, per gallon will make a cheap light, what do you think of the same amount of light from a gallon of **crude** gasoline at **eight** cents per gallon here. J. D. P.

(E)

The product of one barrel of crude petroleum or benzine, averaging about 3,000 feet of pure gas **in actual working,** is equal to 15,000 cubic feet of coal gas in lighting power, and can be diluted with air or non-illuminating gas, until it reaches that bulk, or used pure as desired. In the latter case only 1 and 1½ feet burners need be used, the light from the latter size, reaching as high by Bunsen photometer, as 27½ candles, the cost of the light is only about one-fifth that of coal gas. Among other uses the gas is especially adapted to the supply of single residences, hotels and factories.

It will enable associations of ten or more families living within the limits of a small village to have their own gas works, and street lamps, at a comparatively small cost; and for a joint stock company, will pay a handsome interest, where a coal gas works would not pay expenses. J. D. P.

(F)

The following expressions of the press and citizens of Sunbury are the result of nearly two years experience with this gas:

"The method of registering gas consumed, in dollars and cents, and basing the price upon the **quality of gas,** instead of the old way of cubic feet, we believe will in a few years, be the general costum, as every consumer can see at any time at a glance how much money he pays for his light. Whereas he who pays by the cubic foot for gas which may be of ten candle power, or may be of sixteen candle power, never knows how much money he is to pay for his light, nor how much light he has for his money."—[Sunbury Gazette of Jan. 20, 1872.

The undersigned consumers of gas in the borough of Sunbury, Pa., subscribe to the following, as a true statement of their views in regard to it:

We find that the supply is uniform in quantity and quality as can be desired.

That a burner giving a very satisfactory light averages in cost about one cent per hour.

That, as far as our observation extends we are well satisfied with it as we would be with coal gas as we see it in neighboring towns.

That we have observed no obstruction to its burning caused by any condensation from cold or other cause.

We are satisfied that it burns as well, or better in our street lamps than any we have seen elsewhere.

We are satisfied with the method of registration in dollars and cents, and that the standard of illuminating power, namely: a fourteen candle flame for one cent per hour is maintained as far as ordinary observation enables us to judge.

We are satisfied that the cold of winter has no appreciable effect on the illuminating qualities of the gas.

In fact we are generally contented and pay our bills satisfied that there is nothing better or cheaper in the way of illumination.

Signed by

Hon. J. B. PACKER, Member of Congress.
Hon. WM. L DEWART, Ex-Member of Congress.
Hon. ALEXANDER JORDAN Ex-President Judge.
Hon. WM. M. ROCKEFELLER Pres't Judge
S. P. WOLVERTON Esq. Attorney at Law.
W. I. GREENOUGH Esq., Attorney at Law
S. J. PACKER, Esq., Cashier First National Bank.
JAMES BOYD Esq., Coal Dealer.
JOHN HAAS Esq. Coal Dealer.
T. H. PURDY, Esq., Attorney at Law
SOLOMON MALICK Esq., Attorney at Law. (Chief Burgess)
And the principal business men of Sunbury.

GAS IN PURDYTOWN.

"We hear that Mr. Purdy, Judge Rockefeller and others have made arrangements with the Gas Company for the extension of the gas mains to Purdytown. The principal object being the illumination of the elegant new mansions of the above named gentlemen. We don't wonder that those who have been in the habit of using the light furnished by our Gas Company should be unwilling to do without it in their new residences. The GAZETTE has been from the first, when the manufacture and supply of petroleum gas was first introduced, a firm believer in its efficacy and cheapness, and we are glad that time has only strengthened our original views. We hope the citizens of those streets not provided with main pipe will follow the example of the Purdytown people."—[Sunbury Gazette of October 10, 1873.

COPY OF REPORT OF ASHLAND COMMITTEE.

ASHLAND, Pa., July 8, 1874.

To the Board of Directors of the Ashland Gas Light Company.

GENTLEMEN:—We, the undersigned your committee of investigation to examine the gas as manufactured under the Patton Patent beg leave to report, that we find upon careful and critical examination:

1st. That the process of manufacture is very simple.

2nd. That the gas gives entire satisfaction to the consumers.

3rd. That the price of the gas is lower than coal gas.

4th. That the gas gives a clear white light and does neither smoke nor omit an odious flavor.

5th. That we are satisfied there is less smell in the manufacture of the gas than there is in any other known to your committee.

6th. That we have made a careful examination of the cost to consumers which we attach hereunto for your examination.

7th. After a very careful examination of one of them we are satisfied that the meters used under the Patton patent are far preferable to those used under the old process, because they register in dollars and cents instead of by the cubic foot, thus making it at once intelligible and satisfactory to the consumer.

8th. Your committee in view of all the foregoing facts are satisfied that this gas is that which should be adopted by the Ashland Gas Light Company, because it is good and can be furnished at a lower price than any other, all of which is most respectfully submitted.

F. TRETTER,
HENRY S. BONER, } Committee.

ERRATA.

The last lines on page 1 should read, **"and the more nearly an apparatus or process approaches the fulfillment of these conditions, without fully accomplishing them, the more liable it is to deceive."**

The expression **"Comparison with other Illuminants,"** should constitute the head of page 2.